

# Health Consultation

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Review of Air-Quality Data from January 2000 Sampling Event  
Amoco Oil Company Site, Sugar Creek, Missouri

AMOCO-SUGAR CREEK  
(a/k/a AMOCO OIL COMPANY)

SUGAR CREEK, JACKSON COUNTY, MISSOURI

EPA FACILITY ID: MOD007161425

JUNE 22, 2004

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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**Prepared by:**

**Petition Response Section  
Exposure Investigation and Consultation Branch  
Division of Health Assessment and Consultation  
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## List of Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
AML	Acute myelogenous leukemia
Amoco	Amoco Oil Company
ATSDR	Agency for Toxic Substances and Disease Registry
CREG	Cancer risk evaluation guide
EFR	Enhanced fluid recovery
EMEG	Environmental media evaluation guide
EPA	U.S. Environmental Protection Agency
IARC	International Agency for Research on Cancer
LPG	Liquified petroleum gases
m <sup>3</sup>	Cubic meter
MDNR	Missouri Department of Natural Resources
ND	Not detected
NTP	National Toxicology Program
ppb	Parts per billion
ppm	Parts per million
PVP	Property value protection
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
TFE	Total fluids extraction
µg	Microgram
VOC	Volatile organic compounds

## 1 Purpose and Health Issues

The Amoco Oil Company (Amoco) site is located in Sugar Creek, Missouri. The Norledge area of Sugar Creek, adjacent to the site's southern boundary, is an area at particular risk for off-site migration of groundwater contaminants. The Norledge area contains approximately 130 residences. As part of its Property Value Protection (PVP) program for the Norledge neighborhood, Amoco began purchasing homes and preparing them for availability on a rent-to-own basis.

The Agency for Toxic Substances and Disease Registry (ATSDR) received a request from Amoco on March 10, 2000, to review January 2000 indoor air sampling results from eight Amoco-owned homes in the Norledge area. An Amoco contractor conducted the air sampling event. This health consultation evaluates only the January 2000 air sampling data from these eight Amoco-owned homes for public health significance. This health consultation is one of many ATSDR activities at this site. Details about other ATSDR evaluations are contained in the public health action plan section of this health consultation (see Section 6).

## 2 Background

### 2.1 Site Description

The Amoco Oil Company began petroleum refinery operations in Sugar Creek, Missouri, in 1904. Crude oil was brought in by pipeline from several states. The former refinery produced gasoline, distillate fuels, jet fuels, residual fuels, asphalt, petroleum coke, liquified petroleum gases (LPG), sulfur, and polymers (TriTechnics Corporation 1995). Although petroleum refinery operations ceased in 1982, Amoco has continued to use portions of the site as a light oil petroleum product

marketing terminal, a pipeline facility, and an asphalt receiving and processing center (TriTechnics Corporation 1995).

While the refinery was operational, the site consisted of numerous process units and several storage tank areas. Leaded gasoline and naphtha were used on site (EPA 2001b). Numerous spills and leaks occurred throughout the site.

## **2.2 Land Use**

The Amoco site occupies approximately 500 acres on both sides of Sugar Creek (see Figure 1, Appendix A). The Missouri River bounds the site to the north, wooded areas are on the East Bluff and West Bluff, and residential areas are to the south (TriTechnics Corporation 1995). The Norledge area is adjacent to the south side of the site. The Atchison Topeka & Santa Fe and the Missouri Pacific railroad lines run through the northern portion of the site.

## **2.3 Demographics**

According to the 2000 U.S. Census of Population and Housing (Bureau of the Census 2001), the demographic statistics for locations within 1 mile of the Amoco site indicated there were 9,708 persons residing in 4,446 households. Of these, 92.2% were white; 1.4% were black; 0.7% were American Indian and Alaska Native; 0.6% were Asian; 1.0% were Native Hawaiian and Other Pacific Islander; 1.6% were members of other races; and 2.5% were members of two or more races. There were 927 children 6 years of age or younger, and 1,393 adults 65 years of age and older. Please refer to Figure 2, Appendix A, for additional demographic statistics.

## **2.4 Remediation Activities in the Norledge Area**

Amoco refinery operations were regulated under the Resource Conservation and Recovery Act (RCRA). When refinery operations ceased, a RCRA Facility Investigation (RFI) identified potential sources, areas, and characteristics of contamination to be investigated (TriTechnics Corporation 1995). Since the 1995 RFI report was submitted to the U.S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR), the agencies have taken a different approach to completing the RFI process. Due to public concern, the agencies have focused most of the investigation on the off-site plume area. Amoco has since submitted an RFI report focused solely on the off-site plume area that includes the Norledge area of Sugar Creek. This was done to expedite investigations and to implement clean-up activities in the off-site area. Subsequent investigations will be conducted in a phased manner for the remainder of the site (EPA 2001a).

Groundwater investigations have identified one off-site area of benzene contamination and two off-site areas of free product (that is, free floating petroleum) contamination in the Norledge area (TriTechnics Corporation 1995). Amoco began efforts to recover free product in the late 1950s and to control the migration of hydrocarbons dissolved in groundwater in the 1960s, through construction of interceptor drain systems and trenches (TriTechnics Corporation 1995). This program was expanded in the 1970s and 1980s with the construction and expansion of the Norledge Interceptor Trench Recovery Network. In addition to the interceptor trench, interim measures include enhanced fluid recovery (EFR) and total fluids extraction (TFE) (BP 2002).

On a biweekly schedule Amoco conducts EFR on wells in the Norledge area. During the EFR process a vacuum truck is connected to each well to extract fluid and vapors. Free product is collected for recycling, contaminated groundwater is sent to a treatment system, and vapors are treated by activated carbon canisters. To maximize the effectiveness of the process, the locations of the EFR events are adjusted periodically (BP 2003). Since this EFR activity began, levels of

contamination have decreased (EPA 2002). EFR has been successful in assisting in the natural attenuation of volatile organic compound (VOC) concentrations in groundwater; benzene concentrations have been decreasing (BP 2003). Monitoring wells located in the Norledge area are monitored and sampled quarterly. EFR will continue until a final corrective remedy is approved and installed (BP 2003).

The TFE system is similar to the EFR system in that fluids (including groundwater, free product, and soil vapor) are removed. Additionally, TFE stimulates the biodegradation of hydrocarbons by introducing oxygen through the subsurface (BP 2002). The TFE system consists of nine horizontal wells. The first two horizontal recovery wells were installed and pilot-tested in late 1999 and seven additional horizontal wells started operations in early 2001. As of April 2002, the TFE system met shutdown criteria and the Confirmation Monitoring Program began (BP 2003). Approximately 87,300 pounds of hydrocarbon were removed during the system's operation, with the greatest mass removal from biodegradation (68,600 of the 87,300 pounds) (BP2003).

Underground pipelines also are being investigated. Starting in the 1970s, Amoco began to replace underground pipelines with above-ground pipelines to reduce the potential for undetected releases (TriTechnics Corporation 1995). (Amoco's active pipelines currently enter the site from the eastern and northern borders.) Two of Amoco's old product pipelines run through the Norledge area — one along Northern Street and one along Carlisle Street. Williams Natural Gas currently owns the pipeline that runs along Northern Street and the line supplies natural gas to the local power plant. The line that runs along Carlisle Street was abandoned in the early 1980s (EPA 2001a). The decommissioned underground lines were flushed with water during 1986B1987. However, a leaking pipe in a tank dike indicated that some product remained in the lines after the flushing occurred. EPA requested that Amoco prepare a plan for investigating underground pipelines. As part of future investigations, Amoco will address underground piping and other subsurface structures (EPA 2001b).

Remedial activities in the Norledge area should result in a decrease in contaminant concentrations in the future. Therefore, any potential contribution from these media (groundwater and soil vapor) to indoor air levels should decrease as well.

## **2.5 January 2000 Environmental Data Collection**

On January 31, 2000, Amoco's contractor collected an indoor air sample (24-hour sample interval) from each of the eight Amoco-owned homes in the Norledge area (Amoco 2000). A duplicate sample was collected from one of these homes. No homes were reportedly located over areas of contaminated groundwater (ThermoRetec 2000). Remedial activities should prevent the groundwater plume from migrating further off-site. The samples were collected from the basement of six of the homes and from the bedroom of two of the homes. The homes were unoccupied at the time of sampling. The samples were analyzed for benzene, toluene, ethyl benzene, and xylenes. ATSDR received and reviewed the laboratory analysis of the sampling event. There were no quality assurance issues.

## **3 Discussion**

ATSDR evaluates contaminants detected in environmental media at hazardous waste sites and determines whether an exposure to the contamination has public health significance. ATSDR begins this evaluation by reviewing existing environmental data to determine if the levels of contaminants are above health-based comparison values. Health-based comparison values are media-specific chemical concentrations that are not likely to result in adverse health effects. Once the environmental data have been obtained and evaluated, ATSDR determines whether people were, or continue to be, exposed to the contaminants (see Appendix B).

ATSDR staff determined that a completed exposure pathway to indoor air is likely to exist for people who move into these eight Amoco-owned homes in the future. Inhalation would be the main route of exposure. At this time, these eight unoccupied Amoco-owned homes currently represent an eliminated exposure pathway because no residents are currently breathing the air in these homes (see Table 1, Appendix A).

Benzene was detected in only one sample (the duplicate sample). Assuming the concentration is representative, ATSDR compared the concentration in this sample, 1.8 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), to ATSDR=s cancer risk evaluation guide (CREG) comparison value of 0.1  $\mu\text{g}/\text{m}^3$ . Because the detected concentration exceeds the CREG screening value, further evaluation is performed. This benzene concentration is within background levels found in the United States (see Appendix C). This benzene concentration also is within the range of concentrations previously evaluated in other ATSDR reports on the quality of indoor air in Norledge area homes (not detected (ND) to 70  $\mu\text{g}/\text{m}^3$ ). As ATSDR states in its November 2000 and May 2004 public health assessments, exposure to these levels of benzene are not likely to be associated with adverse health effects under site-specific conditions of exposure. Refer to Appendix C for additional information on benzene.

Ethyl benzene and o-xylene were not detected during this January 2000 sampling event. Toluene concentrations ranged from ND to 19.2  $\mu\text{g}/\text{m}^3$ , which are below ATSDR=s chronic environmental media evaluation guide (EMEG) of 3,800  $\mu\text{g}/\text{m}^3$ . M&P-xylene concentrations ranged from ND to 3.8  $\mu\text{g}/\text{m}^3$ , which are below ATSDR=s chronic EMEG of 430  $\mu\text{g}/\text{m}^3$  for total xylenes. No adverse health effects would be expected from exposure to the detected levels of these chemicals.

## 4 Conclusions

A completed exposure pathway to indoor air is likely to exist for people who move into these eight Amoco-owned homes in the future. Although chronic inhalation might occur in the future, the current contaminant levels detected in indoor air are not likely to be associated with adverse health effects. Remedial activities in the Norledge area should result in a decrease in groundwater contaminant concentrations in the future. Therefore, any potential contribution from groundwater to indoor air levels should decrease as well. ATSDR therefore categorizes future chronic exposures to indoor air in these eight Amoco-owned homes as presenting *No Apparent Public Health Hazard*<sup>1</sup>.

## 5 Recommendations

ATSDR has no specific recommendations at this time. However, the agency will review additional indoor air data for public health significance, upon request.

## 6 Public Health Action Plan

The actions described in this section are designed to ensure that this health consultation identifies public health hazards and provides a plan of action to mitigate and prevent adverse health effects resulting from exposure to hazardous substances in the environment. In addition, the results of each ATSDR site-specific activity and evaluation are provided. Where applicable, ATSDR includes a commitment to follow up on this plan and ensure that it is implemented.

### **Actions Completed:**

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<sup>1</sup> The phrase *No Apparent Public Health Hazard* is a formal conclusion category that ATSDR reserves for sites where human exposure to contaminated media is occurring, has occurred in the past, or will occur, but the exposure poses no health hazard.

- # May 3, 1999: ATSDR reviewed and provided comments to the Missouri Department of Health regarding their report entitled, "The Sugar Creek Cancer Inquiry Report - Level 2 Investigation, March 23, 1999.@"
- # May 7, 1999: ATSDR released its first public health assessment for public review and comment. ATSDR concluded in the initial public comment version of the public health assessment that the Norledge area of Sugar Creek poses an *Indeterminate Public Health Hazard*<sup>2</sup> because only limited data for indoor air were available and no data for surface soil were available. ATSDR's recommendations included sampling indoor air and surface soil.
- # May 1999: ATSDR released an easy-to-understand fact sheet summarizing its findings from the May 1999 public health assessment document. This fact sheet was included as an insert in the *Sweet Talk Newsletter* released in June 1999.
- # June 2, 1999: ATSDR conducted a public meeting and public availability sessions during the public comment period of the May 1999 public health assessment to address questions about the document and to collect additional community concerns.
- # September 1999: ATSDR published an article in the *Sweet Talk Newsletter* to provide residents with an update on its activities in the Sugar Creek Community.
- # March 29, 2000: ATSDR released a public health assessment addendum for public review and comment. ATSDR determined that current, chronic exposures to the contaminant levels detected in indoor air are not likely to be associated with adverse health effects.
- # April 2000: ATSDR released an easy-to-understand fact sheet summarizing the agency's findings from the March 2000 public health assessment addendum. This fact sheet was included as an insert in the *Sweet Talk Newsletter* released in May 2000.
- # April 12, 2000: ATSDR released this health consultation, "Review of Air-quality Data from January 2000 Sampling Event", for public review and comment. ATSDR determined that the contaminant levels detected during an indoor air sampling event are not likely to be associated with adverse health effects.
- # May 1, 2000: ATSDR released a health consultation, "Review of February 2000 Soil Data", for public review and comment which evaluated Norledge area surface soil data provided

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<sup>2</sup> The phrase AIndeterminate Public Health Hazard@ is a formal conclusion category that ATSDR reserves for sites at which, due to the unavailability of critical information, no determination can be made regarding the existence or non-existence of a potential threat to health in the community.

by the EPA. No adverse health effects would be expected from exposure to this soil during activities such as gardening or playing.

# June 27, 2000: ATSDR reviewed and provided comments to the Missouri Department of Health regarding its report entitled, "The Sugar Creek Cancer Inquiry Report - Level 3 Investigation, March 3, 2000".

# August 28, 2000: ATSDR released a health consultation, "Surface Water and Sediment Data Review", for public review and comment which evaluated surface water and sediment data provided by the Missouri Department of Natural Resources. On the basis of the data provided, ATSDR determined that surface water and sediment contaminants are not a public health threat to residents in the Norledge neighborhood. However, because the data were limited, ATSDR recommended additional surface water and sediment sampling in the off-site portions of Sugar Creek.

# November 29, 2000: ATSDR's May 1999 public health assessment was released final and included the agency's responses to comments received on the initial public comment version. ATSDR concluded that short-term exposures to the levels of contaminants detected in indoor air are not likely to be associated with adverse health effects. Potential intermittent exposures to subsurface soils would also be unlikely to result in adverse health effects. No exposures to groundwater were identified.

# December 8, 2000: ATSDR released a health consultation, "Review of March 2000 Sediment and Surface Water Data" which evaluated surface water and sediment data provided by the Missouri Department of Natural Resources. On the basis of the data provided, ATSDR determined that exposures to on-site surface water and sediment in the tank berms and off-site surface water and sediment in the drainage ditch and seepage areas would not be expected to result in adverse health effects. However, because the data were limited, ATSDR recommended additional off-site surface water and sediment sampling in the seepage area and the drainage ditch.

# December 8, 2000: ATSDR released a health consultation, "Indoor Air in Two Residences in the Norledge Area" which evaluated indoor air sampling data provided by the Amoco Oil Company. On the basis of the data provided, ATSDR determined indoor air exposures to the levels detected would not be expected to produce adverse health effects.

# December 19, 2000: ATSDR released a health consultation, "Review of 1996 Water and Soil Data" which evaluated water and soil data from the Norledge area. On the basis of the data provided, ATSDR determined that exposures to water and soil by children playing in Sugar Creek should not result in adverse health effects. However, because the data were limited, ATSDR recommended additional surface water and sediment sampling in Sugar Creek.

# April 23, 2001: ATSDR released a health consultation, "Review of October 2000 Soil and Surface Water Data" which evaluated surface water and soil data provided by the U.S.

Environmental Protection Agency. On the basis of the data provided, ATSDR determined that intermittent exposures to surface water and subsurface soil in Sugar Creek and the seepage area would not be expected to result in adverse health effects.

# June 25, 2001: ATSDR released a health consultation, "Review of Ambient Air Data" which evaluated ambient (that is, outdoor) air sampling data collected by the Missouri Department of Natural Resources. On the basis of the data provided, ATSDR determined ambient air exposures in the Norledge area would not be expected to produce adverse health effects.

# November 19, 2001: ATSDR provided technical assistance by reviewing the results of one surface water sample and one soil sample collected at the intersection of Carlisle and Northern streets in Sugar Creek, MO. ATSDR determined that the water and soil samples indicated levels of chemicals that are unlikely to result in adverse health effects.

# September 17, 2002: ATSDR provided technical assistance to the EPA by reviewing the results of surface water and sediment samples collected in Sugar Creek, MO. On the basis of the limited data provided, ATSDR determined that surface water and sediment samples indicated levels of chemicals that are unlikely to result in adverse health effects.

# May 20, 2004: ATSDR's March 2000 public health assessment addendum was released final and included the agency's responses to comments received on the initial public comment version. ATSDR determined current, chronic exposures to the contaminant levels detected in indoor air are not likely to be associated with adverse health effects.

#### **Actions Planned:**

# ATSDR will evaluate additional environmental data for the Norledge area for public health significance, upon request. Results of these evaluations will be provided to the public in subsequent ATSDR documents.

## **7 Public Comment**

ATSDR released the preliminary version of this health consultation for public review and comment from April 12, 2000, through May 22, 2000. Appendix D of this final health consultation contains both the comments received during the public comment period and ATSDR=s responses to those comments

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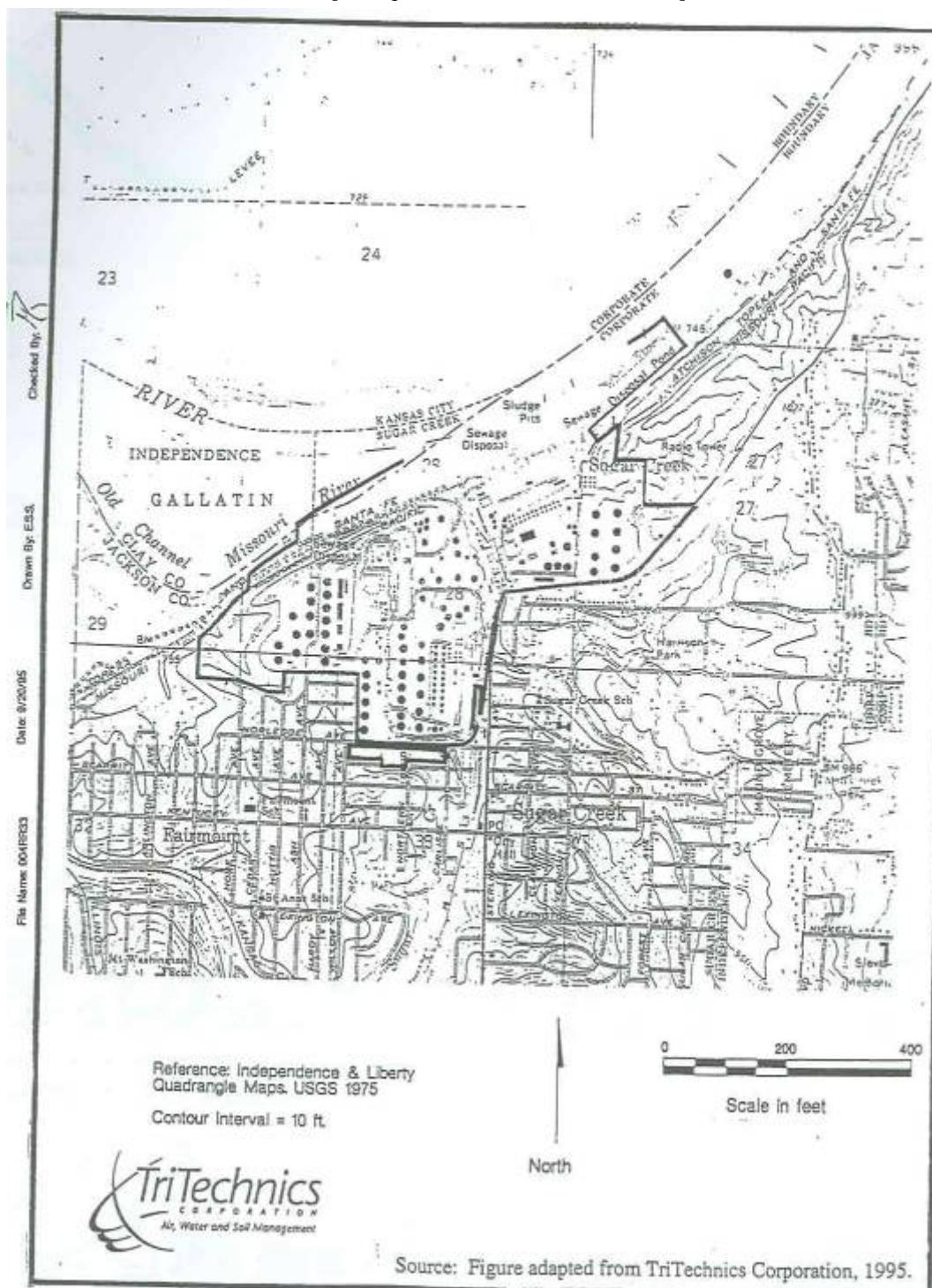
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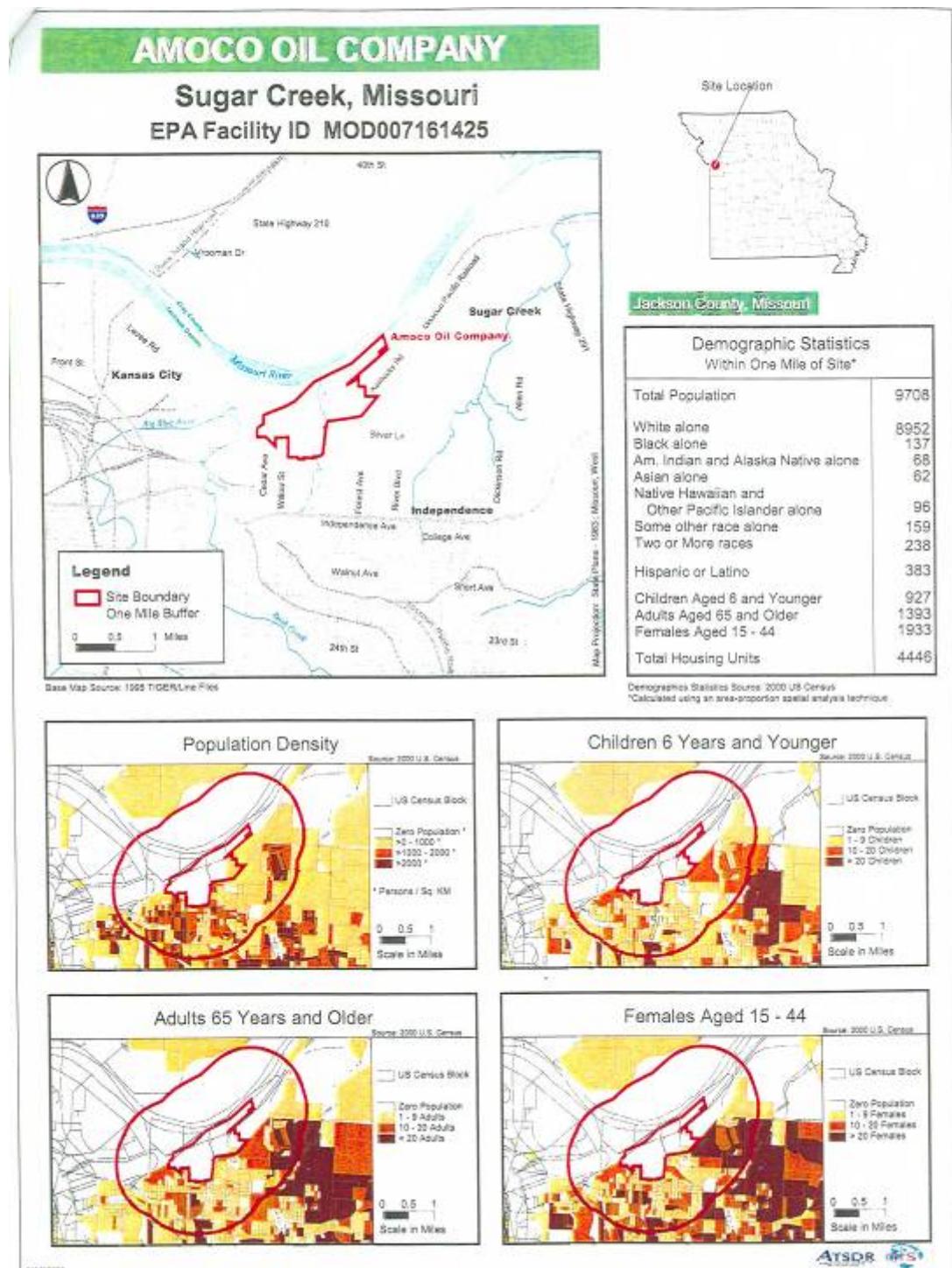
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## **Appendix A B Figures and Tables**

**Figure 1: Amoco Oil Company Site Location Map**

**Figure 2: Demographic Statistics**

**Table 1: Off-site Exposure Pathway Elements**

Pathway Name	Exposure Pathway Elements					Time Frame
	Source	Media	Point of Exposure	Route of Exposure	Exposed Population	
<b>Completed Exposure Pathway</b>						
Air (indoor)	Amoco; other sources in the home	Indoor Air	Amoco-owned homes in the Norledge area	Inhalation	People who reside in these homes	Future
<b>Eliminated Exposure Pathway*</b>						
Air (indoor)	Amoco; other sources in the home	Indoor Air	Eight unoccupied Amoco-owned homes in the Norledge area	None	None	Current

\* The indoor air exposure pathway is only eliminated until these eight Amoco-owned homes are reoccupied.

## **Appendix B ATSDR Methodology**

## **ATSDR Methodology**

ATSDR addresses the question of whether exposure to contaminants at the maximum concentrations detected would result in adverse health effects. While the relative toxicity of a chemical is important, the human body's response to a chemical exposure is determined by several additional factors, among which are

- the concentration (how much) of the chemical to which the person was exposed,
- the amount of time the person was exposed (how long), and
- the way the person was exposed (through breathing, eating, drinking, or direct contact with something containing the chemical).

Lifestyle factors (for example, occupation and personal habits) have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution affect how a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of all these factors will determine the individual's physiologic response to a chemical contaminant and any adverse health effects the individual may suffer as a result of the chemical exposure.

ATSDR evaluates contaminants detected in environmental media at a site and determines whether an exposure to them has public health significance. ATSDR begins this evaluation by gathering reports that contain relevant environmental data for the site. These data are reviewed to determine whether contaminant levels are above health-based comparison values. Health-based comparison values are estimates of the daily human exposure to a substance that are not likely to result in adverse health effects over a specified duration of exposure. These values are developed for specific media (such as air and water) and for specific durations of exposure (such as acute and chronic).

Comparison values represent conservative levels of safety and not thresholds of toxicity. Thus, although concentrations at or below a comparison value may reasonably be considered safe, concentrations above a comparison value will not necessarily be harmful. Comparison values are intentionally designed to be much lower, usually by orders of magnitude, than the corresponding no-effect levels (or lowest-effect levels) determined in laboratory studies to ensure that even the most sensitive populations (such as children or the elderly) are protected.

To determine whether people are being exposed to contaminants or whether they were exposed in the past or will be exposed in the future, ATSDR examines the path between a contaminant and a person or group of people who could be exposed. Completed exposure pathways have five required elements. ATSDR evaluates each possible pathway at a site to determine whether all five

factors exist and people are being exposed, were exposed, or may be exposed in the future. These five factors or elements must exist for a person to be exposed to a contaminant:

- (1) a source of contamination
- (2) transport through an environmental medium
- (3) a point of exposure
- (4) a route of human exposure, and
- (5) an exposed population.

ATSDR classifies exposure pathways in one of the following three categories.

- *Completed Exposure Pathway.* ATSDR calls a pathway “complete” if it is certain that people are exposed (or were exposed or will be exposed) to contaminated media. Completed pathways require that the five elements exist and indicate that exposure to the contaminant has occurred, is occurring, or will occur.
- *Potential Exposure Pathway.* Potential pathways are those in which at least one of the five elements is missing, but could exist. Potential pathways indicate that exposure to a contaminant could have occurred, could be occurring, or could occur in the future.
- *Eliminated Exposure Pathway.* In an eliminated exposure pathway, at least one of the five elements is missing and will never be present. From a human health perspective, pathways can be eliminated from further consideration if ATSDR is able to show that (1) an environmental medium is not contaminated or that (2) no one is exposed to contaminated media.

## **Appendix C B Benzene**

## Benzene

Benzene (benzol or coal tar naphtha), a known human carcinogen, and is classified as such by the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC), the U.S. Environmental Protection Agency (EPA), and the American Conference of Governmental Industrial Hygienists (ACGIH).

Benzene is a common solvent isolated from coal tar and crude oil. Although it is naturally released into the atmosphere as an emission of volcanoes, forest fires, and even many plants, the primary sources of benzene exposure for the general population are tobacco smoke (50%), automobile service stations, vehicle exhaust and industrial emissions (20%), and vapors from benzene-containing household products such as glues, paints, furniture wax, and some detergents (ATSDR, 1997). Environmental exposure to benzene has recently been reviewed by the EPA (Wallace, 1996). More than 99% of personal exposure to benzene is through the air, averages about  $15 \text{ }\mu\text{g/m}^3$  (4.7 parts per billion (ppb)) and ranges from 7 to  $29 \text{ }\mu\text{g/m}^3$  (2 to 9 ppb). These values reflect the results of the EPA's Total Exposure Assessment Methodology (TEAM), a study conducted between 1980 and 1987 using personal air quality monitors to measure direct personal exposures in about 800 persons around the United States. This sample was designed to be representative of the non-occupational exposure of 800,000 people in these areas.

Due partly to the domestic use of household products and partly to home insulation, indoor air concentrations (on the order of  $10 \text{ }\mu\text{g/m}^3$  or 3.1 ppb) typically exceed outdoor air concentrations, which average  $6 \text{ }\mu\text{g/m}^3$  (1.9 ppb) and range from 2 to  $19 \text{ }\mu\text{g/m}^3$  (0.6 to 5.9 ppb). (Note: air concentrations of benzene may be converted from  $\mu\text{g/m}^3$  to ppb by dividing by 3.2, or from ppb to  $\mu\text{g/m}^3$  by multiplying by 3.2.) Levels in the city are generally higher than those in rural areas. Average rural background levels of benzene in air historically range from 0.1 to 17 ppb (IARC, 1982). More current figures for the range of average rural background levels in the U.S. are not available. However, since 1986, statewide average levels at about 20 sites throughout California fluctuated between 1.6 and 2.2 ppb until 1993 and 1994 when they dropped to about 1.25 ppb, probably as a result of various actions taken to reduce automobile emissions (Wallace, 1996). Average levels were higher in winter and lower in summer.

In smokers, the benzene in mainstream cigarette smoke overwhelms all other sources combined. The average smoker may be exposed to 10 times as much benzene as is the average non-smoker (Wallace, 1996). For non-smokers, most benzene exposure is ultimately derived from automobile exhaust and gasoline vapor emissions (Egeghy et al 2000). No significant effect on personal exposure has been detected in persons living close to major fixed sources of benzene, such as oil refineries, storage tanks, and chemical plants (Wallace, 1996).

The lowest human effect levels reported in ATSDR=s recently updated ATSDR Toxicological Profile for Benzene; that is, 690 ppb for leukopenia (Xia et al 1995) and 300 ppb for leukemia (Ott et al 1978), are 31 and 13 times higher, respectively, than the highest level of benzene detected in indoor air in the Norledge area. These values (690 ppb and 300 ppb) represent the lowest measured concentrations in a range of industrial hygiene measurements in each facility in the two studies, which were 690–140,000 ppb and 300– 35,000 ppb, respectively. Using the lowest measured concentration as an indicator of exposure in the facilities is conservative and will likely underestimate actual exposures. Assuming a normal dose-response relationship in which lower doses are less toxic than higher ones and consistent with the epidemiological and toxicological literature (Paustenbach et al 1992, Rinsky et al 1997, Wong 1995), any adverse effects caused by benzene would be expected to occur in workers exposed to the higher, rather than the lower, end of those exposure ranges. In an update of the Ott study, it was noted that “workers who died of leukemia had the potential for unquantified, but potentially high, exposures to benzene” (Bond et al 1986).

ATSDR=s benzene CREG is based primarily on studies of U.S. workers (the Pliofilm cohort) exposed to high levels of benzene (up to hundreds of ppm or hundreds of thousands of ppb) during rubber manufacture, mostly during the 1940s. Like all CREGs, it is based on an EPA-estimated cancer slope factor which is in turn based on the assumption that the dose-response relationship is constant with dose; that is, that the proportion of effects seen at high doses will be the same in the low-dose range where the effects are unmeasurable.

Available studies indicate no detectable excess of leukemia below cumulative exposures of 40 ppm-years<sup>3</sup> (Rinsky et al 1987). This would be numerically, if not biologically, equivalent to about 190 ppb, 24 hours a day, over a 70-year lifetime. However, this apparent threshold is most likely an underestimate because it is based on underestimated exposures and the inclusion of all leukemias, not just acute myelogenous leukemia (AML). When only AML is considered, the estimated threshold was found to be at least 200 ppm-years (numerically equivalent to 950 ppb, 24 hours a day, over a 70-year lifetime), based on the original set of exposure estimates, and higher still using later, more accurate exposure estimates (Paustenbach et al 1992, Wong 1995).

For the reasons discussed in this appendix, none of the estimated benzene exposures in the Norledge area would be expected to produce any adverse health effects of either a cancerous or non-cancerous nature.

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<sup>3</sup>The notation “ppm-year” represents a numerical attempt to integrate the levels and durations of exposure observed in occupational studies as a product of the two. A worker exposed to 2 ppm for 20 years and one exposed to 20 ppm for 2 years both received the “same” cumulative exposure that is, expressed in ppm-years. The distinction is made between numerical and biological equivalence because, although an aspirin a day for 70 years would be numerically equivalent to 70 aspirin a day for 1 year, the two dose rates would produce very different biological effects. Although the first dose regimen might protect one from cardiovascular disease the second would be lethal.

**References:**

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## **Appendix D B Public Comments**

## Appendix D: Public Comments

ATSDR released its health consultation, Amoco Oil Company Review of Air-quality Data from January 2000 Sampling Event, for public review and comment from April 12, 2000, through May 22, 2000. Each comment received was logged and became part of the administrative record. This appendix contains both the comments received during the public comment period and ATSDR's responses to those comments. The comments have been numbered with the response directly following each comment.

**Comment 1:** In January 2000, Amoco Oil Company submitted results of indoor air sampling it conducted in the Norledge area, Sugar Creek, Missouri, homes. Prior to their purchase by Amoco, these homes were occupied by families with children or by senior citizens. These people were neighbors. And most of them are dying younger and harder than they should.

Despite the hardship of moving and financial setback, most of the residents found their ever-present concern for health and safety to be too great to ignore. Amoco's contamination has broken the neighborhood and forced these people from their long time homes. When Amoco shut down the refinery in 1982, it scattered its employees. Now, Amoco is buying up the neighborhood and scattering the sick and diseased out of our zip codes.

Amoco air sampled in their new Property Value Protection (PVP) properties and of course found no contaminant levels of concern to human health. What a surprise! Amoco also co-opted an Environmental Protection Agency (EPA) benzene study to opine that the background benzene levels in the Norledge area were no greater than the air in 39 metropolitan areas. Amoco seems to consider Sugar Creek's air quality to be no worse than Chicago or New York. Amoco fails to understand that Sugar Creek isn't New York, Houston or any other metroplex.

Neither the EPA, Missouri Department of Natural Resources (MDNR), ATSDR, or Missouri Department of Health (MDOH) were there to protect the residents of Sugar Creek when the residents witnessed the plumes of smoke and particulates floating over their homes, the fires raging on the water of Sugar Creek, the pure gasoline in the natural springs and the "midnight at noon" when Amoco's smokestacks belched their pollutants into the neighborhood. How many of those people wondered at that very moment if what they were seeing, breathing, eating, or touching could hurt or kill them? Or their children? The agencies existed but just took a powder when it came to opposing Amoco.

**Response 1:** ATSDR appreciates this community perspective of historic activities. The agency became aware of this site in June 1998, when the agency was petitioned to conduct a public health assessment of the site. During the intervening years, ATSDR released two public health assessments, eight health consultations, and two technical assists<sup>4</sup> evaluating environmental data collected primarily in the Norledge area. On the basis of ATSDR's evaluation of current and future exposure pathways and the detected contaminant levels, no adverse health effects would be expected. Section 6 of the main text contains a summary of each of these ATSDR documents.

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<sup>4</sup> An ATSDR technical assist is a verbal health consultation that is documented in ATSDR's record of activity system.

ATSDR was not able to evaluate past exposures during the time the facility was operating because off-site air data were not available from that time frame. The agency did, however, consider other options to address residents' health concerns about past exposures. One of these options — modeling past indoor air concentrations — was not feasible. A second option, targeted specifically at residents' concerns about multiple sclerosis (MS), was feasible. In fact, through the Jackson County Health Department, ATSDR is funding a prevalence study to determine if higher rates of MS exist in Sugar Creek. Thirdly, to address concerns about cancer rates, ATSDR played an active role in reviewing the Missouri Department of Health's (MDOH's) cancer cluster investigations. Therefore, although ATSDR's public health assessments and health consultations focused on current and future exposure pathways, the agency supported other options to address past exposure concerns.

**Comment 2:** The ATSDR's and MDOH's inclination towards poorly scoped and conceived studies have left the residents in a state of confusion about the poisons to which they were exposed during refinery operations. Like zip codes and cancer registries, what better way to avoid finding a wild elephant than to look in the North Pole? Face it, we didn't get cancer, brain tumors or leukemia just last year! It started 20, 25, 30, 40, 50 or more years ago.

**Response 2:** Please see Response 1 regarding ATSDR's evaluation of site-specific exposures.

MDOH investigated brain cancer, leukemia, and lymphoma. Its Level 2 inquiry showed mixed evidence for an incident brain cancer cluster and no evidence of a cluster of incident cases of leukemia or lymphoma (MDOH 2000). The MDOH's Level 3 inquiry showed mixed evidence of a time and space clustering of brain cancer cases (MDOH 2000). The Level 4 inquiry determined it would not be feasible to undertake an etiologic study of environmental petrochemical exposure and primary brain cancer in Sugar Creek (MDOH 2001). However, MDOH will continue cancer surveillance in this area (MDOH 2001).

The results of an independent brain cancer cluster investigation found no statistically significant increase in the number of brain cancer cases in the community, although there are several limitations in this investigation (Neuberger et al 2003).

**Comment 3:** It is galling when the ATSDR obediently rubber stamps Amoco's January 2000 report on face value, with no effort to ensure Amoco followed proper quality assurance standards or that the sampling results are accurate. Did you even receive or review the laboratory analysis on the sampling?

**Response 3:** ATSDR received and reviewed the laboratory analysis of the January 2000 sampling event. There were no quality assurance issues.

**Comment 4:** It's obvious that neither ATSDR nor any other government environmental agency conducted oversight of Amoco's testing, just as no government agency was informed Amoco was going to be conducting the testing for this purpose.

**Response 4:** As part of its Property Value Protection (PVP) program for the Norledge

neighborhood, Amoco began purchasing homes and preparing them for availability on a rent-to-own basis. The January 2000 sampling event was conducted as part of Amoco's rent-to-own program and Amoco forwarded the results to EPA.

**Comment 5:** In the January 2000 report, ATSDR quotes ThermoRetec as saying none of the houses were over the plume of contaminated groundwater. If this is true, why did Amoco avoid air sampling in the properties above the benzene plume?

**Response 5:** Amoco sampled these homes as part of its rent-to-own program. Through a series of public health assessments and health consultations, ATSDR reviewed numerous indoor air samples collected in homes located over the benzene plume. No contaminants are at levels of health concern.

**Comment 6:** From October 1999 through January 2000, Amoco has purchased a significant number of Norledge properties, any of which it could have conducted air sampling with government agency oversight at any time. Why did Amoco avoid sampling over the plume?

**Response 6:** Please see Response 5. With regard to the homes chosen for sampling as part of the rent-to-own program, please contact Amoco directly.

**Comment 7:** ATSDR should avoid the appearance of impropriety as it rubber stamps Amoco's testing as posing No Apparent Public Health Hazard. ATSDR needs to take a stronger position towards Amoco, especially since Amoco intends to rent these properties to unsuspecting tenants.

**Response 7:** ATSDR reviewed the indoor air sampling results and determined the contaminant levels were not of health concern.

**Comment 8:** ATSDR should request the EPA require Amoco to air sample on a monthly basis in all of the homes Amoco has purchased. Without a complete body of environmental health data, no representative of a health agency can ever presume to credibly inform a resident of Sugar Creek that no health hazard exists in the Sugar Creek/Independence area surrounding Amoco's former refinery.

**Response 8:** Through a series of public health assessments and health consultations, ATSDR reviewed numerous indoor air, outdoor air, groundwater, soil, surface water and sediment samples collected throughout the Norledge area. No contaminants are at levels of health concern. And, remedial activities in the Norledge area should result in a decrease in contaminant concentrations in the future.

**Comment 9:** Right now an opportunity exists to gather environmental health data but it may be missed without immediate action. Amoco intends to demolish the homes it has purchased under the PVP program. If Amoco is allowed to tear down these properties before comprehensive air, soil, and groundwater sampling can be conducted, the health agencies will lose a golden opportunity to evaluate the current environmental impact of Amoco's pollution. Without knowing the current levels, the past levels can never be monitored.

**Response 9:** As stated previously, ATSDR reviewed numerous indoor air, outdoor air, groundwater, soil, surface water and sediment samples collected throughout the Norledge area. No contaminants are at levels of health concern.

**Comment 10:** ATSDR should request the EPA require Amoco to (1) allow the regulatory agencies unlimited access to all PVP properties for unlimited environmental testing and oversight, (2) conduct air sampling on a monthly basis for a year utilizing methods most likely to imitate a completed exposure pathway to residents, and (3) prohibit the rental of PVP properties until the EPA or MDNR issues it a “clean bill of health” generally in the form of a “No Further Action” letter for each property.

**Response 10:** On the basis of the agency’s review of the available data, ATSDR has no recommendations at this time.

## References:

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